

## Claims

What is claimed is:

1. A lensed fiber, comprising:  
an optical fiber; and  
a lens formed at a distal end of the optical fiber, the lens having a minimum diameter determined by  $2 \cdot T \cdot \tan(\theta)$ , where  $\theta = n \cdot \sin^{-1}(NA)$ , T is thickness of the lens, n is index of refraction of the lens, and NA is numerical aperture of the optical fiber.
2. The lensed fiber of claim 1, wherein a radius of curvature of the lens is not smaller than a mode field radius of a mode in the lensed fiber at an apex of the lens.
3. The lensed fiber of claim 1, wherein a radius of curvature of the lens is in a range from approximately 50 to 5,000  $\mu\text{m}$ .
4. The lensed fiber of claim 3, wherein a thickness of the lens is in a range from approximately 15 to 18,000  $\mu\text{m}$ .
5. The lensed fiber of claim 3, wherein a distance to beam waist in air of the lens is in a range from approximately 0 to 100 mm.
6. The lensed fiber of claim 3, wherein a mode field diameter at beam waist of the lens is in a range from approximately 3 to 1,000  $\mu\text{m}$ .
7. A method of making a lensed fiber having an optical fiber and a lens, comprising:  
splicing an optical fiber to a coreless fiber;  
reducing the coreless fiber to a desired length based on a desired thickness of the lens;  
and  
laser machining a predetermined radius of curvature at a distal end of the coreless fiber.
8. The method of claim 7, wherein the coreless fiber has a minimum diameter determined by  $2 \cdot T \cdot \tan(\theta)$ , where  $\theta = n \cdot \sin^{-1}(NA)$ , T is the desired thickness of the

lens,  $n$  is index of refraction of the lens, and NA is numerical aperture of the optical fiber.

9. The method of claim 7, wherein reducing the coreless fiber to the desired length comprises cleaving the coreless fiber to the desired length.
10. The method of claim 7, wherein reducing the coreless fiber to the desired length comprises taper-cutting the coreless fiber to the desired length.
11. The method of claim 7, wherein the desired length of the coreless fiber is at least equal to the desired thickness of the lens.
12. The method of claim 7, wherein the desired length of the coreless fiber is greater than the desired thickness of the lens.
13. The method of claim 12, wherein laser machining the predetermined radius of curvature comprises reducing the desired length of the coreless fiber to the desired thickness of the lens.
14. A method of making a lensed fiber having an optical fiber and a lens, comprising:  
 splicing an optical fiber to a coreless fiber having a minimum diameter determined by  $2 \cdot T \cdot \tan(\theta)$ , where  $\theta = n \cdot \sin^{-1}(NA)$ ,  $T$  is thickness of the lens,  $n$  is index of refraction of the lens, and NA is numerical aperture of the optical fiber;  
 reducing the coreless fiber to a desired length based on the thickness of the lens; and  
 forming a predetermined radius of curvature at a distal end of the coreless fiber.